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# Effects of The Jigsaw II and Scaffolding Strategies on Students' Attitude Biology in Ekiti State, Nigeria

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**Abstract:**

This study investigated the effects of Jigsaw II and scaffolding instructional strategies on senior secondary school students' attitudes towards Biology in Ekiti State, Nigeria, using a quasi-experimental pre-test, post-test, control group design. Two experimental groups and one control group were used, with 187 Senior Secondary School II (SSS II) students sampled through multistage sampling. The experimental groups received interventions using Jigsaw II and scaffolding strategies, while the control group was taught using conventional methods. Students' attitudes were measured using the Biology Attitudinal Scale (BAS), validated through expert review and tested for reliability, yielding a Cronbach's alpha value of 0.89. The results showed no significant differences in students' attitudinal mean scores across the groups before treatment ($p > 0.05$), indicating group homogeneity at baseline. However, significant differences emerged post-treatment ($p < 0.05$), with students exposed to scaffolding achieving the highest attitudinal gains, followed by those in the Jigsaw II group. Mean differences of 28.28 and 27.39 were observed for scaffolding and Jigsaw II groups, respectively, compared to a negligible 2.87 for the control group. The Scheffe post-hoc analysis confirmed the superiority of scaffolding and Jigsaw II over the conventional method in enhancing students' attitudes towards Biology. The study concluded that scaffolding and Jigsaw II strategies are effective in promoting positive attitudes towards Biology among students, with scaffolding showing slightly greater impact. These findings

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underscore the need to adopt innovative instructional strategies in Biology education to enhance student engagement and attitude, particularly in contexts like Ekiti State, where traditional methods dominate.

**Keywords:** Jigsaw II, Scaffolding, Students, Attitude, Biology,

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## Introduction

Secondary school Biology curricula in Nigeria aim to pique students' interest in and knowledge of biology while simultaneously preparing them to make informed decisions about their own and others' health, as well as about environmental and agricultural concerns (Federal Republic of Nigeria, 2013). At the senior high school, biology is available as a standalone course. This cohort of students must have taken Basic Science and Technology in Junior Secondary School (J.S.S. 1–3) in order to be well-prepared for the scientific courses offered in senior high. Because it requires less mathematical calculations than Physics and Chemistry, Biology has been shown to be the science course that senior high school students prefer. Consequently, students majoring in Biology are more likely to enrol in Biology classes and take external exams like the West African Senior School Certificate Examination (WASSCE) than students majoring in Physics or Chemistry. Prospective medical, pharmacy, nursing, medical laboratory science, biotechnology, and agricultural students, among others, need to take this crucial scientific course in college. Therefore, Biology is a distinct subject in the high school curriculum.

The learning outcome of students may be gauged by their attitude. Attitude can be shaped by someone else's words or deeds, such as those of one's parents, teachers, classmates, or friends. According to Michael and Gwyneth (2014), one's attitude may be described as their behaviour in relation to something, which in turn reveals their thoughts and feelings about that item. An individual's learnt inclination or tendency to react favourably or unfavourably to an item, circumstance, idea, or other person is known as their attitude. A person's attitude may be shaped by their exposure to new information and by their use of various persuasive strategies (Sarmah & Puri, 2014). The teaching and learning of biology are greatly influenced by students' attitudes towards the subject, which also has an impact on their academic success. Even when professors try to explain Biology in a genuine and context-dependent manner, many students still end up disliking the subject because of how it is portrayed in class and how they perceive it. Students may succeed in Biology if they approach the subject with a positive mindset.

One of the things that might influence how students feel about Biology class is the approach taken by the instructor. As a result, the significance of instructional tactics in the classroom becomes much clearer. In their opening lectures, Jegede (2023) and Omotayo (2023) listed a number of methods for teaching and learning science, including: teams, think-peer-share, online labs, jigsaw II, scaffolding, projects, concept mapping, CAS, games, role-playing, sport-based learning, science quizzes, science at home, reward discovery, science clubs, science stations, crossover learning, and many more. The usage of the traditional technique in teaching secondary school biology is one of the main reasons why students perform poorly on biology exams. The traditional approach to education has been panned for its alleged focus on memorization-based knowledge transmission and has been deemed an inadequate strategy for instructing students in Biology and other scientific disciplines (Robert, 2011).

According to Afurobi, et al (2015), the conventional method, which is also called the lecture method, is simply when the instructor knows all there is to know about a certain subject in the curriculum and shares that knowledge with the students. By ignoring students'

background knowledge and empowering the teacher to act as the ultimate arbiter of all information in a given subject, this style of instruction turns students into mindless followers who do nothing more than listen and repeat what the teacher says. Although there is nothing intrinsically wrong with this approach, it becomes more teacher-centered than learner-centred when students are marginalised and expected to do nothing more than take notes while the teacher is portrayed as being all-knowing and superficial (Durosaro & Adegoke, 2011). Innovative strategies like jigsaw II, blended learning, scaffolding, games and simulations, spaced-learning, problem-based learning, field trips, and team teaching, among others, were discovered in the quest to address the shortcomings of the conventional method used in teaching and learning Biology. The jigsaw II and scaffolding tactics are the ones that this study focusses on since they are both thought to be beneficial in enhancing students' attitudes towards and performance in Biology.

As a teaching approach, Jigsaw II has students of varying abilities work in small groups to apply what they've learnt through a range of activities (Ariyana, 2013). For students to learn class information effectively, use the Jigsaw II method. Undertaking this approach will help students become more attentive and involved in a group environment. Each group member is like a piece of a jigsaw puzzle; they all fit together perfectly. Members of the group cooperate to accomplish a shared objective, which is the secret ingredient to this strategy's success. Without collaboration, students will fail (Chan, 2014). There are two groups that students participate in under this method: one is the "expert" group, and the other is the "jigsaw" or "home" group. The jigsaw or home group method of instruction has students study discrete chunks of content. The home group is to divide up the reading assignments so that everyone may concentrate on one section. Students who have completed the reading create an expert group to debate the given section after finishing it. Members return to their home groups to share the knowledge they gained during the conversation with their peers. Each member of the group takes a quick test once the other has covered all of the material covered by the experts. An individual's improvement score is determined by comparing their score to the base score. Then, the average improvement score for the group is calculated from there. A group award is provided to the group that achieves the greatest average group improvement score as a kind of group acknowledgement. Another option is to offer group rewards to those whose average group improvement score reaches a certain level. So, everyone learns and helps everyone else learn, since when one person succeeds, the whole group succeeds. Because of this, the jigsaw II co-operative learning technique helps students develop a lifelong habit of learning and collaboration.

As part of the scaffolding learning technique, teachers provide students with initial assistance to build on their existing skills while simultaneously introducing and encouraging them to achieve new goals (Wu, Weng & She, 2016). Because teachers typically lend a hand with the more challenging assignments that students have never faced before in class, they help students gain confidence in their abilities and knowledge while also preparing them to apply what they already know to new situations. With the goal of empowering students to tackle the seemingly impossible job alone, teachers employ a transient kind of support known as scaffolding throughout their lessons. As the student shows signs of having learnt the material

and is able to accomplish the activity on their own, the instructor may progressively reduce the level of help they are receiving (Aditi, 2017). The strategy's overarching goal, then, is to help students become more independent thinkers and problem solvers. Teachers can aid their students' learning by providing them with examples, clues, suggestions, partial answers, think-aloud modelling, and direct instruction (Robinson & Daniel, 2017). In turn, this might aid the instructor in catering to students' individual learning styles, which in turn would make the process more welcoming to all students as they would all be considered vital cogs in the wheel.

The impact of the jigsaw learning technique on students' inclusive learning, attitude, and accomplishment in human respiratory was studied by Ahiakwo et al. (2023). The results revealed that students who learnt about the respiratory system using a jigsaw technique did better than their classmates who learnt about the same material through a lecture method and also had a more positive outlook on class participation. This supports the idea that being in a classroom setting gives students a sense of community.

In contrast to studies focussing on cognitive processes and IQ, Neeta (2018) examined the impact of scaffolding on scientific achievement. For the experimental group, the instructor planned and implemented instructional materials based on scaffolding-based instructions. Conventional methods were used to teach the Control group. The dissimilarity between the learners' pre- and post-tests was used to document their gain scores. The following findings were reported by the researcher: (i) Compared to the team trained using the conventional approach, the one using scaffolding instructional method had much greater levels of success. (ii) Neither level of cognitive approach showed a statistically significant difference in achievement. (iii) Compared to a low-intelligence team, a high-intelligence team achieved quite a bit more. (iv) Neither the instructional nor the cognitive approaches had a major impact on the outcome of the conversation. (v) The realisation score was unrelated to the nature of the instruction or the student's IQ. (vi) Teams that relied on cognitive approaches did not show any statistically significant correlations with IQ. (vii) Although methodology and IQ independently impact the achievement gain score, there is no statistically significant association between the three.

Based on the foregoing, the study examined the effects of the jigsaw II strategy, scaffolding strategy, and conventional method on senior secondary school students' attitude towards Biology in Ekiti State, Nigeria.

**Research Hypotheses**

The following null hypotheses were formulated for this study.

1. There is no significant difference in the attitudinal mean score of students in jigsaw II, scaffolding strategies, and conventional method in Biology before treatment.
2. There is no significant difference in the attitudinal mean score of students exposed to jigsaw II, scaffolding strategies, and conventional method in Biology after treatment.
3. There is no significant difference in the attitudinal mean scores of students exposed to jigsaw II, scaffolding strategies, and conventional method in Biology before and after treatment.

**Research Method**

Two experimental groups and one control group were used in this quasi-experimental pre-test, post-test, control group design. Since this study examined the effects of two instructional tactics, jigsaw II and scaffolding procedures, on students' attitudes towards Biology, the quasi experimental design was found acceptable. While the post-test, givena following the therapy, gauged students' attitudes towards Biology, the pre-test confirmed the homogeneity of the groups. One may see the study's design as follows: Experimental Group 1 (E1) got the jigsaw II instructional strategy; Experimental Group 2 (E2) got the scaffolding instructional strategy; and the Control Group (C) got the conventional teaching technique. Pre-test observations (O1, O3, O5) and post-test observations (O2, O4, O6) were utilised to evaluate results before and following the treatments.

According to the Ekiti State Ministry of Education (2023), the population of the study consisted in 12,525 Senior Secondary School Two (SSS II) students from 210 public secondary schools spread throughout the sixteen Local Government Areas in Ekiti State, Nigeria. Given their exposure to fundamental biological ideas and their capacity for autonomous, minimally supervised research, the choice of SSS II students was judged reasonable. SSS II students also lacked participation in external test preparations, therefore guaranteeing their availability for the study.

Drawn from entire classrooms at the chosen public secondary schools, the sample comprised 187 SSS II students. The sample came from a multistage sampling method. First, using a basic random sample method, one senatorial district—from the three in Ekiti State—was chosen. Second, using the same process, three Local Government Areas were picked from the designated district. Two public secondary schools from every one of these Local Government Areas were stratified and randomly chosen thirdly. The intact courses were then employed for the research after these institutions were randomly assigned to the two experimental groups and one control group. To carry out the instructional techniques, teachers in the chosen institutions underwent training as research assistants.

The Biology Attitudinal Scale (BAS) consists of two components and measures students' attitudes towards biology. While Section B included 25 items scored on a 4-point Likert scale ranging from Strongly Agree (SA) to Strongly Disagree (SD), Section A gathered demographic information. Positive items scored from 4 to 1; bad items scored the reverse. Expert evaluations from biology educators, test and measurement experts, seasoned biology teachers, and the researcher's supervisor helped to demonstrate the BAS's validity. To be sure the tool fairly assessed students' views, experts assessed it for clarity and subject appropriateness. Twenty students outside the research sample were given the BAS to evaluate dependability. Using the odd-even approach, responses were divided and subjected to Cronbach's Alpha analysis to provide a reliability value of 0.89—which was regarded as good.

Pre-treatment, treatment, and post-treatment made up three parts of the experimental process. The researcher visited the chosen schools during the pre-treatment phase, spoke with principals and Biology instructors, and taught research assistants how to use the instructional tactics. Every group got pre-tests to guarantee homogeneity. Students in the

Jigsaw II group collaborated in a variety of groups during the six-week treatment phase, with tasks discussed in both expert and home groups. Groups headed by the most experienced students used the scaffolding approach, working under direction that the research assistant progressively withdrew. Conventional teaching techniques were used in the meantime for the control group. To gauge the effects of the instructional strategies, the BAS was re-administered during the post-treatment phase.

There were instructional packages catered to every group. The jigsaw II package comprised a thorough course of instruction designed to support group projects, whole-class assessments, and group recognition of high performance. While the control group followed the regular lesson plan using conventional scaffolding techniques, the scaffolding package concentrated on organised group activities with gradual withdrawal of support. Descriptive and inferential statistics were applied in analysis of the study's gathered data. Research questions were addressed using means, standard deviations, and bar graphs. Analysis of Variance (ANOVA) tested Hypotheses 1 through 2; Analysis of Covariance (ANCOVA) tested Hypothesis 3. Every hypothesis underwent 0.05 level of significance testing.

## Results

**Table 1:** Mean and standard deviation of pre-test and post-test attitudinal scores of students in experimental and control groups

| Strategies | Test | N | Mean | S.D | Mean Diff. |
|---|---|---|---|---|---|
| Jigsaw II | Pre Test | 57 | 42.68 | 5.87 | **27.39** |
| | Post Test | | 70.07 | 8.37 | |
| Scaffolding | Pre Test | 61 | 43.70 | 5.16 | **28.28** |
| | Post Test | | 71.98 | 6.63 | |
| Conventional | Pre Test | 69 | 42.81 | 4.86 | **2.87** |
| | Post Test | | 45.68 | 5.54 | |
| **Total** | | **187** | | | |

Table 1 revealed that the pre-test attitudinal mean scores of students exposed to the jigsaw II strategy was 42.68 while the scaffolding strategy was 43.70 with the conventional method found to be 42.81 with their corresponding standard deviations as 5.87, 5.16 and 4.86 respectively in Biology. The post-test attitudinal mean scores of students exposed to jigsaw II , scaffolding strategies and conventional method were 70.07, 71.98 and 45.68 respectively with their corresponding standard deviations as 8.37, 6.63 and 5.54 respectively in Biology. The mean difference in each of the strategy (jigsaw II and scaffolding ) was found to be 27.39 and 28.28 respectively while that of the conventional method was found to be 2.87. It appears that the use of jigsaw II and scaffolding strategies influences students' attitudes towards Biology with the scaffolding strategy being the most effective strategy closely followed by the jigsaw II strategy. The result is further depicted in figure i.

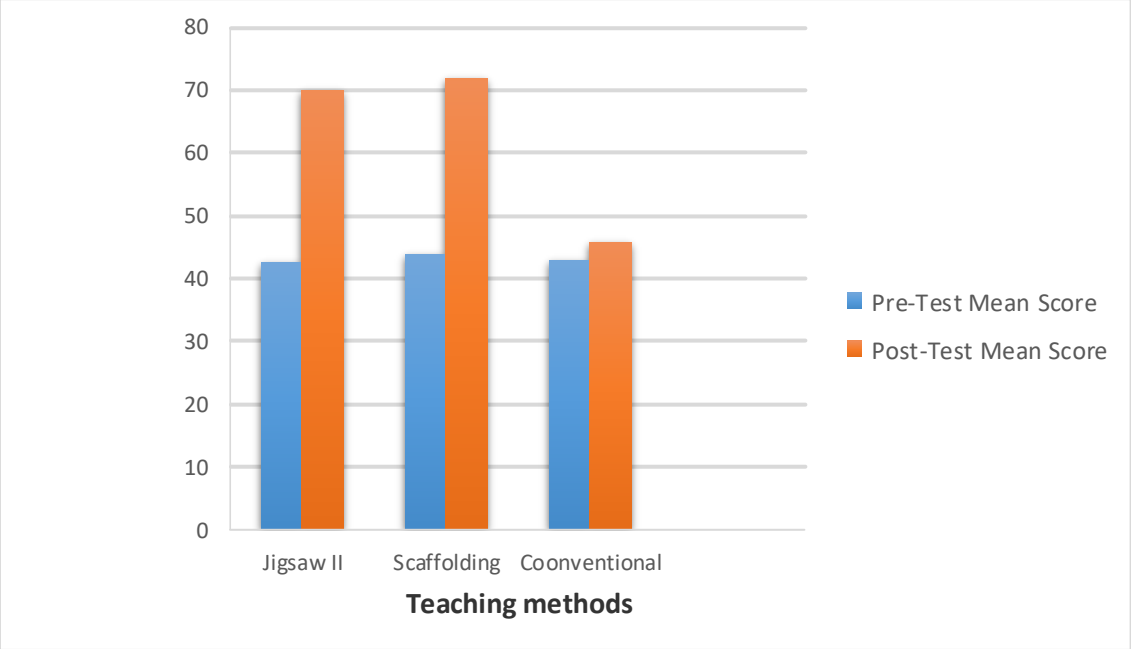


**Figure i:** Barchart on the attitude of students before and after treatments in Biology

**Testing of Hypotheses**

**Hypothesis 1:** There is no significant difference in the attitudinal mean score of students exposed to jigsaw II, scaffolding strategies and conventional method in Biology before treatment.

**Table 2:** ANOVA showing the difference in attitude of students towards Biology in experimental and control groups before treatment.

| | | | | | |
|---|---|---|---|---|---|
| | 37.675 | 2 | 18.837 | | |
| | 5131.555 | 184 | 27.889 | 0.675 | .510 |
| | **5169.230** | **186** | | | |

P > 0.05

The result presented in table 2 showed that the F-cal value of 0.675 was not significant because the P value (0.510) > 0.05 at 0.05 level of significance. Hence, the null hypothesis was not rejected. This implies that there was no significant difference in the attitudinal mean score of students in the jigsaw II, scaffolding strategies, and conventional method in Biology before treatment. These findings implied that the students in the experimental and control groups were homogeneous at the commencement of the study.

**Hypothesis 2:** There is no significant difference in the attitudinal mean score of students exposed to Jigsaw II, scaffolding strategies and conventional method in Biology after treatment.

**Table 3:** ANOVA showing the difference in attitude of students towards Biology in experimental and control groups after treatment.

| | | | | | |
|---|---|---|---|---|---|
| | 28149.937 | 2 | 14074.969 | | |
| | 8653.688 | 184 | 47.031 | 299.271* | .000 |
| | **36803.626** | **186** | | | |

*P < 0.05

The result presented in table 3 showed that the F-cal value of 299.271 was significant because the P value (0.000) < 0.05 at 0.05 level of significance. Hence, the null hypothesis was rejected. This implies that there was a significant difference in the attitudinal mean score of students after being exposed to the jigsaw II, scaffolding strategies and conventional method. To determine the source of the significant differences observed, Post – hoc (Scheffe) analysis with mean difference was carried out in Table 4.

**Table 4:** Scheffe Post – hoc multiple range test of the attitude of students towards Biology in experimental and control groups after treatment.

| **Groups** | | **N** | **Mean** | **A** | **B** | **C** |
|---|---|---|---|---|---|---|
| | | | | 70.07 | 71.98 | 45.68 |
| Jigsaw II | **(A)** | 57 | 70.07 | | | |
| Scaffolding | **(B)** | 61 | 71.98 | | | |
| Conventional | **(C)** | 69 | 45.68 | * | * | |

* P < 0.05

In Table 4, significant differences were found between the attitude of students towards Biology after being exposed to jigsaw II, scaffolding strategies and conventional method in favour of students exposed to scaffolding strategy.

**Hypothesis 3:** There is no significant difference in the attitudinal mean score of students exposed to jigsaw II and scaffolding strategies and conventional method in Biology before and after treatments.

**Table 5:** Analysis of Covariance for effects of jigsaw II and scaffolding strategies and conventional method on students' attitude towards Biology before and after treatment.

| Source | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Corrected Model** | 28276.164[a] | 3 | 9425.388 | 202.270 | .000 |
| **Intercept** | 8495.365 | 1 | 8495.365 | 182.311 | .000 |
| **Before** | 126.227 | 1 | 126.227 | 2.709 | .102 |
| **Treatment Groups** | 27946.883 | 2 | 13973.441 | 299.871* | .000 |
| **Error** | 8527.462 | 183 | 46.598 | | |
| **Total** | 748581.000 | 187 | | | |
| **Corrected Total** | 36803.626 | 186 | | | |

a. R Squared = .768 (Adjusted R Squared = .764)

The result presented in table 5 shows that there was a significant difference in the attitudinal mean scores of students exposed to jigsaw II and scaffolding strategies and conventional method in Biology before and after treatments as $F_{cal}$ = 299.871, P= 0.000<0.05. This result led to the rejection of the null hypothesis. This implies that there was a significant difference in the attitudinal mean scores of students exposed to jigsaw II and scaffolding strategies and conventional method before and after treatment in Biology. To find out the more probable effective strategy, Multiple Classification Analysis (MCA) was carried out. The result is shown in Table 6.

**Table 6:** Multiple Classification Analysis (MCA) of students' attitude in Biology by treatment

| Grand Mean = 61.70 | | | | | |
|---|---|---|---|---|---|
| Variable + Category | **N** | **Unadjusted Dev'n** | **Eta²** | **Adjusted for Independent + Covariate** | **Beta** |
| **Jigsaw II** | 57 | 8.37 | .88 | 8.29 | .54 |
| **Scaffolding** | 61 | 10.28 | | 10.23 | |
| **Conventional** | 69 | -16.02 | | -16.08 | |
| Multiple R<br>Multiple $R^2$ | | | | | .876<br>.768 |

The result in Table 6 shows the Multiple Classification Analysis (MCA) of students' attitudes towards Biology by treatment. It reveals that, with a grand mean of 61.79, students exposed to the scaffolding strategy had the highest adjusted mean score of 71.98(61.70+10.28), followed by the students exposed to the jigsaw II strategy with an adjusted mean score of 70.07(61.70+8.37), and conventional method with adjusted mean score of 45.68(61.70+(-16.02)). This means that students exposed to scaffolding had better attitudes toward Biology than students exposed to the jigsaw II strategy and conventional method. The treatment

explained about 88% ($Eta^2$ = 0.88) of the observed variance in students' attitudes towards Biology. The treatment strategies accounted for 76.8% ($R^2$ = 0.768) contribution to the attitude of the students towards Biology.

**Discussion**

The study's findings indicated no significant difference in the attitudinal mean scores of students utilising jigsaw II and scaffolding tactics compared to the conventional approach prior to therapy. The data indicate that the students in both the experimental and control groups were homogenous at the beginning of the research.

The study indicated a notable disparity in the attitudinal mean scores of students subjected to jigsaw II, scaffolding tactics, and conventional methods post-treatment. Students exposed to the scaffolding technique had a more favourable attitude towards Biology than those exposed to the jigsaw II strategy and the traditional method. This conclusion aligns with Vikoo's (2011) research, which examined the impact of cooperative (scaffolding) strategies against conventional teaching on Senior Secondary School students' attitudes towards Biology, demonstrating the strategy's success. Wu, Weng, and She (2016) concluded that scaffolding approaches affected scientific knowledge and attitudes towards learning.

This outcome is significant as it indicates that the scaffolding method positively influenced students' perceptions of Biology. Scaffolding, which entails offering help and direction to students during their learning process and progressively withdrawing that support as their competence increases, appears to have fostered a more positive attitude among the students in this study. Conversely, the jigsaw II technique and the traditional method did not provide equivalent enhancements in attitude. The discovery of a substantial difference highlights the efficacy of the scaffolding method in improving students' attitudes towards the subject matter. The design and implementation of the scaffolding method facilitated students' development of a more positive and responsive attitude towards Biology. This may be ascribed to the systematic assistance and direction offered by scaffolding, which likely enhanced students' confidence, engagement, and ability to comprehend and value the subject.

**Conclusion**

Based on the findings of this study, it could be concluded that the three groups (jigsaw II, scaffolding strategies, and conventional method) were homogeneous at the commencement of the experiment. The use of the scaffolding strategy enhanced a better attitude towards Biology than the jigsaw II strategy and conventional method.

**Recommendations**

Based on the findings of this study, the following recommendations were made:

1. Curriculum planners should incorporate innovative strategies such as jigsaw ii and scaffolding strategies in the senior secondary school curriculum.
2. Biology teachers should explore the possibility of combining different teaching strategies. For instance, integrating elements of both the jigsaw ii and scaffolding strategies might provide a more comprehensive learning experience for students.
3. School management should advise teachers on the effective management of time considering the procedure involved in both jigsaw II and scaffolding strategies.

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